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UNITED STATES DEPARTMENT OF AGRICULTURE

FOREST SERVICE RO

COPY

REPLY TO: 3420

DATE: August 4, 1987

SUBJECT: Evaluation of Annosus Root Disease in the Little Horse Timber Sale Area, Goosenest Ranger District (Report No. 87-15)

TO: Forest Supervisor, Klamath National Forest

At the request of Walt Bavarskas, Goosenest Ranger District, Gregg DeNitto, FPM pathologist, visited the Little Horse Timber Sale area (T. 43N, R. 1W, sections 24 and 25) on July 29 and 30, 1987. The purpose of the visit was to determine the level of annosus root disease, caused by Fomes annosus, in the stands so that the District could decide on the need for borax treatment. The adjacent Stevens Timber Sale is being logged and stumps are being treated.

The sale area is approximately 850 acres. Two stand types are present: eastside pine and mixed conifer. Ponderosa pine is the main species in the former, while the latter contains primarily white fir with some ponderosa pine. Some lodgepole pine are present in wetter areas. Site quality varies from Meyer's class 1 to 4, but most of the area is 2 and 3. Most of the units have been marked for commercial thinning.

In portions of unit CT62, Walt had observed pockets of dead ponderosa pines. He was suspicious that the mortality was caused by F. annosus because of the stand type and the known presence of the disease in surrounding areas. From examination of the roots of the dead trees and the pattern of mortality, it was determined that annosus root disease was not involved in the mortality. Galleries of mountain pine beetle, Dendroctonus ponderosae, were observed in the boles. Stocking levels were high in the vicinity of these mortality pockets, with basal area measurements of 300 to 320 sq.ft./ac. being taken. It was concluded that the mortality in unit CT62 was a result of mountain pine beetle activitiy in association with overstocking. Additional mortality will probably occur in these stands this year, especially with the below normal moisture conditions. Thinning the stands as planned should reduce future mortality.

Because of the presence of F. annosus in the vicinity and the need to justify the additional cost of borax treatment, a survey was done to estimate present levels of the disease in the sale area. Two stands, CT62 and CT64, were selected for examination because they were at geographically opposite ends of the sale area and they represented the two stand types. CT62 is eastside pine and CT64 is mixed conifer. Pine stumps were examined in each unit for conks of F. annosus. East-west transects were followed and stumps excavated as they were encountered. Thirty stumps were examined in each unit.

In unit CT62, F. annosus was found in 11 of the 30 stumps. Thirteen of the 30 stumps in unit CT64 had conks. Most conks discovered were old and were only recognizable as remnants. Recent mortality was not observed around any of these stumps, although many of them were in openings in the stand. Stumps were readily recognized, but deterioration was advanced.

It appears that these F. annosus centers are not presently active. The area was railroad logged and tractor logged once before, but the most recent logging was at least 30 years ago. A hypothesis is that stumps became infected in the first entry and the amount of annosus root disease increased in the stand. The fungus grew through the root systems and may have infected and killed surrounding conifers. In time, the food base was depleted and the fungus lost its ability to spread further through the roots. It is known that F. annosus can remain alive and active in stumps for several decades. The fungus may have reached the end of its active phase in these stumps due to their advanced state of deterioration.

At this time, F. annosus does not appear to be actively killing trees in these stands. Spores of the fungus are likely present in the air most of the time, however. Based on infection levels from previous logging, about 40% of the stumps, similar levels can be expected in this entry if pine stumps are not treated with borax. Levels will likely be higher for two reasons. An estimate of 40% is conservative because only definite evidence of F. annosus was counted. Some stumps considered as not infected, may have been, but lacked definitive evidence. Secondly, with the increase in cutting activity in the area, the number of F. annosus spores in the air may be higher than 30+ years ago.

Approximately one-half of the newly created pine stumps may become infected during this entry. Annosus root disease centers that develop will vary in size, but 1/10th acre is an approximate average to use to make any required estimates of potential volume losses. Over 1 to 2 decades, trees in these centers will be killed by the fungus. Salvage may capture some of this volume, but the site will not produce at its optimum prior to the regeneration harvest. These centers will be slow to regenerate because of the lack of natural regeneration on these dry sites without adequate seedbed preparation. Also, the fungus may kill any regeneration that does occur. After the regeneration harvest, infested sites will not successfully regenerate and future volume production will fall below projections for healthy stands.

Based on the above, the District should consider borax treatment of pine stumps in the appraisal for the Little Horse Timber Sale. Some white fir stumps will also be created in this sale and are susceptible to F. annosus. The enclosed position paper provides information on the present policy on the borax treatment of true fir stumps. If you have any questions about this evaluation, please contact Gregg DeNitto at (415) 556-6940.

JOHN NEISESS
FPM Program Leader
State and Private Forestry

POSITION PAPER

BORAX TREATMENT OF TRUE FIR STUMPS IN TIMBER STANDS

Forest Pest Management is frequently asked if, in timber stands, it recommends treatment of true fir (Abies) stumps with borax (sodium tetraborate decahydrate, EPA Reg. No. 1624-94) to prevent infection of these stumps by Fomes annosus. At this time, we can not recommend this treatment, nor can we recommend not treating. Basically, a lack of information is behind our inability to make a recommendation.

Treatment of all conifer stumps in recreation sites is directed (FSM 2305.14, R-5 Supp. 164) because of the assumed high value of the trees. In timber stands, sufficient efficacy information is available to recommend borax treatment of pine stumps, 8 inches or greater in diameter. Until we have this information for true fir, the treatment decision should lie with the appropriate line officer who has been fully briefed on the specific situation in the particular stand in question.

Following are statements concerning the infection process of F. annosus in true fir which would influence the line officer's decision to treat fir stumps with borax. The statements are summarized in Table 1, and their pertinence to true fir vs. pine presented.

1. All true fir stands in the Region are at risk of infection by F. annosus. That is, given a fresh wound in a true fir stem or a fresh stump surface, there is a risk that it will be infected by F. annosus. The following information and observations support this statement:
   a. F. annosus is widely scattered throughout the Region in true fir and mixed-conifer stands (3, 5, 6, 11, 12).
   b. The presence or absence of F. annosus in a stand appears to be related to stand history and to individual stand characteristics which will change with time (5). For example, older stands and stands which have been entered have a higher probability of having annosus root disease.
   c. Spores of F. annosus are present in all true fir stands at all times of the year (Cobb and Smith, unpublished).
   d. Stump surfaces of true firs are readily infected and colonized by F. annosus (10).

2. Forest management activities (stand entries) tend to increase the risk of increasing the levels of F. annosus infection in true fir. This statement is supported by the following:
   a. Statewide surveys of true fir have found a positive correlation between the number of stand entries and the presence of F. annosus infection of true fir (5).
   b. This association has been confirmed in the process of conducting biological evaluations of pest problems in stands containing true fir.
   c. Surveys of true fir wounded during stand entries found that some of these wounds were colonized by F. annosus (1, 2, 8).
   d. The increase in the number of stumps created during forest management activities has the potential to result in increased F. annosus infection in the residual stand.

3. Once a true fir site becomes infested with F. annosus, it may stay infested for many rotations if it is repeatedly regenerated to true fir. An alternate crop of pine or brush appears to reduce the incidence of F. annosus on a particular true fir site (5).

4. Borax treatment of true fir stumps will effectively prevent the infection of stump surfaces (10). However, the efficacy of this treatment in reducing the impact of the disease in a stand has not been pilot tested.

5. Borax treatment of true fir stump surfaces will not prevent the entrance of F. annosus into the root systems of true fir stumps or entrance by other means, nor will it eradicate existing root or stump infections present at the time the tree was cut.

6. F. annosus can enter the true fir in a stand by means other than through fresh stump surfaces. This conclusion is supported by the following:

a. Fomes annosus is found in association with fire scars in virgin true fir stands (L. A. Paine, unpublished).

b. Studies of logging wounds indicate that F. annosus is a colonizer of these wounds (2).

c. Field observations indicate that mycelial infection of root systems of adjacent trees occurs through the spread of F. annosus from one root system to another.

7. True fir stands are often infested with F. annosus before harvest entry. This infestation and the level of infection is difficult to detect and determine because infection in true fir usually results in a heartrot (4) with no above ground crown symptoms produced.

8. The spread of F. annosus by root contact from true fir to pine is rare. Therefore, even if stump surface infection of true fir occurs, it may not affect adjacent pines in the stand. This statement is based on observations in mixed conifer stands (3), on survey data (7; Parmeter and Slaughter, unpublished) from pine plantations established in red fir or mixed conifer stands throughout the northern, central, and southern Sierra, and on laboratory evidence demonstrating different strains of the fungus on pines and on true fir (9).

Information Needs

The above statements have identified the following information needs:

1. What are the levels of F. annosus spores in various forest types, over a wider area of the Region, and during more frequent periods of the year?

2. What is the frequency of true fir stump infection by forest type, location, and season?

3. What is the long term effectiveness of borax treatment of true fir stumps, under various forest types and geographic locations, in reducing incidence of annosus root disease in managed stands?

4. More accurate methods of determining levels of F. annosus infection in true fir and mixed-conifer stands are needed.

5. What is the relationship between infection of true fir stumps and damage to surrounding true firs, especially following partial cuts, to the economical and biological benefit of borax treatment?

Table 1. Statements concerning annosus root disease in forest stands of California.

Statement	Pine	True Fir
1. All stands Region-wide are at a risk of infection.	+	+
2. There is a positive correlation between the number of stand entries and levels of infection.	+	+
3. Once a stand is infested, it may stay infested for many generations if regenerated with the infected host.	+	+
4. Borax treatment of freshly-cut stump surfaces will effectively prevent infection of the stump surfaces.	+	+
5. F. annosus enters only through freshly-cut stump surfaces.	+	-
6. The efficacy of borax stump treatment in stands has been determined.	+	-
7. Level of infestation in a stand is generally visible because root infection produces above ground symptoms.	+	-
8. The spread of F. annosus by root contact to other conifer species is common.	+	-

References

1. Aho, P. E. 1977. Decay of grand fir in the Blue Mountains of Oregon and Washington. USDA Forest Service Res. Paper PNW-299. 18 p.

2. Aho, P. E., Fiddler, G., and M. Srago. 1983. Logging damage in thinned young-growth true fir stands in California and recommendations for prevention. USDA Forest Service, Res. Paper PNW-304. 8 p.

3. Bega, R. V., and R. S. Smith, Jr. 1966. Distribution of Fomes annosus in natural forests of California. Plant Disease Reptr. 50:832-836.

4. Cobb, F. W., Jr., and W. W. Wilcox. 1967. Comparison of susceptibility of Abies concolor and Pinus ponderosa wood to decay by Fomes annosus. Phytopathology 12:1312-1314.

5. DeNitto, G., J. R. Parmeter, Jr., G. Slaughter, and M. Schultz. 1984. Incidence of Fomes annosus in mixed conifer and true fir forests in northern California. USDA Forest Service, Pacific Southwest Region, Report No. 84-11. 12 p.

6. Kimmey, J. W., and H. H. Bynum, Jr. 1961. Heart rots of red and white firs. USDA Forest Service, Forest Pest Leaflet 52. 4 p.

7. Kliejunas, J. T. 1986. Frequency of Fomes annosus spread from true fir stumps to adjacent planted pines. USDA Forest Service, Pacific Southwest Region, Report No. 86-4. 4 p.

8. Maloy, O. C., and V. S. Robinson. 1968. Microorganisms associated with heartrot in young grand fir. Can. J. Bot. 46:306-309.

9. Otrosina, W. J. 1985. Isozyme polymorphism in Fomes annosus. 33rd Annual Western Inter. Forest Disease Work Conference, Olympia. p. 97-99.

10. Smith, R. S., Jr. 1970. Borax to control Fomes annosus infection of white fir stumps. Plant Disease Reptr. 54:872-875.

11. Smith, R. S., Jr. 1984. Evaluation of Fomes annosus stump infection on the Cannell Meadow Ranger District, Sequoia National Forest. USDA Forest Service, Pacific Southwest Region, Report No. 84-37. 5 p.

12. Wagener, W. W., and M. S. Cave. 1946. Pine killing by the root fungus Fomes annosus in California. J. Forestry 44:47-54.

13. Worrall, J. J., J. R. Parmeter, Jr., and F. W. Cobb, Jr. 1983. Host specialization of Heterobasidion annosum. Phytopathology 73:304-307.